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ity tied together by a very close bond, in so far as they are aiming at the real purpose of publication, its usefulness, and that the librarian, the indexer and the reviewer are no less necessary links in the chain between the publishing investigator and his numerous and increasing readers. The practical recognition of this intimate connection is no less necessary for the promotion of the rapid advance of science which the present activity of investigators promises than the unification of the methods of the investigators themselves, and can no doubt be secured in the same manner.

In conclusion, I wish to ask attention for a few minutes to a matter of prime interest to all botanists, since it will probably affect the very prosecution of many of their studies before the next century shall have been closed. I refer to the protection and preservation in every possible way of our native and natural vegetation. To the systematist, the physiologist, and the morphologist, this is alike of importance. Agricultural lands, in the main, of necessity must have their native plants replaced by others if the latter are more valuable to man, as surely as grazing lands have been stocked with cattle after the extermination of the less useful bison. But the erection of an agricultural practice, based on a preliminary clearing of the ground, is quite different from the denudation of the land without further purpose than the utilization of its native products. Primarily the question is an economic one and as such it interests the community at large; but it is also a question of the deepest concern to science. Climatology, the past, present and future geographical distribution of animals and plants, and ecology and evolution are so clearly connected that their devotees possess a common interest in the preservation of natural conditions at least until the factors in biologic nature shall have been directly

ascertained and correlated; and I need scarcely add that what has thus far been done in this direction is little more than a rough blocking out for the future. Hence it is that local societies for the protection of animals and plants are worthy of general support in their efforts, and that the widespread forest protection movement, which is too commonly looked upon as simply an economic or sentimental matter, should receive the united encouragement and support of naturalists and meteorologists as a movement the success of which alone can perpetuate for any great time the conditions upon which much of their profounder study is to rest. This Association is to be asked to endorse an effort for the local preservation of the red-woods over a considerable area in central California, and the location of a forest reserve in the southern Appalachians. It is to be hoped that whatever action may be taken shall rest not upon hasty impulse, but upon such recognition of the vast scientific as well as utilitarian importance of this movement as shall ensure the permanence of our interest in every step of the kind which may originate in the future.

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THE STRUCTURE AND SIGNIFICATION OF CERTAIN BOTANICAL TERMS.

WHILE it is in some sense true that technical names are merely arbitrarily constructed vehicles for conveying ideas on special subjects, in the coining of such terms from the ancient languages for use in scientific description and discussion, it is desirable, at least from an educational point of view, that they should not only be appropriate, but that they should not involve any real etymological error in their construction. From a like point of view it is no less desirable that, when used antithetically, they should be strictly correlative in both con-

struction and signification, as well as relatively constant in each of the three etymological elements which are used in the composition of such terms, namely, the prepositional, verbal and substantival. A considerable number of terms, derived from the Greek, which have come into use in anatomical and physiological botany, while they have been generally accepted and approved, are sadly wanting in some one or more of these requirements. I allude to such terms as heliotropism, geotropism, apogeotropism and diageotropism, which are used with reference to certain plant movements; and to hypocotyl, epicotyl, hyponasty and epinasty, which are used with reference to certain structural conditions.

The terms geotropism and heliotropism, as first proposed by Frank in 1868 and since used by Darwin and botanists generally, are intended to designate respectively the act of the radical portion of plants in turning downward, or toward the earth, and that of the stemmate portion in turning upward, or toward the sun; but in neither case is this accepted signification etymologically the true one. Geotropism being derived from $\gamma\eta$, the earth, and $\tau\rho\pi\sigma\varsigma$, a turn, or turning, literally signifies earth-turning; and heliotropism, being derived from $\lambda\lambda\kappa\varsigma$, the sun, and $\tau\rho\pi\sigma\varsigma$, similarly signifies sun-turning. That is, because they are each composed of verbal and substantival elements only, the prepositional element being omitted, their conventional signification is really far-fetched. Long before either Frank or Darwin used these terms in their present conventional sense, the term heliotrope was used to indicate the habit of the flowering parts of certain plants in facing and following the sun in its daily course. This act being really synheliotropism, or a turning with the sun, is quite different from that which Frank indicated by his special use of the old term. It seems to have been

for this reason that Darwin happily proposed in its stead the term apogeotropism, and for the first time introduced the necessary prepositional element in the construction of this class of botanical terms. Strangely, however, although he at the same time also employed that element in the construction of his term diageotropism, he failed to add it to Frank's term geotropism, which should have been written epi-geotropism* to make it strictly correlative and antithetic with apogeotropism. These two terms, when made to contain three elements each, are appropriate for the use intended because they signify and fully express the acts of turning toward and from the earth without reference to the sun as the assumed objective point of direction.

Before either Frank's or Darwin's incomparable works containing these and related terms reached America I had, as Professor of 'natural history' at the Iowa State University, constructed and personally used in my lectures the terms epitropism and apotropism in the same manner and for the same purpose that Frank's geotropism and Darwin's apogeotropism are respectively used. These terms I derived from Greek prepositional and verbal elements only, namely $\epsilon\pi\iota$, toward, $\alpha\pi\delta$, from, and $\tau\rho\pi\sigma\varsigma$, a turning omitting the substantival element $\gamma\eta$, the earth. Because they are thus shorter and more conveniently useable in their adjective and adverbial forms they seem to be preferable to Frank's and Darwin's corresponding terms, even if the former should be amended by adding the prepositional element. While the omission of either the prepositional or verbal element from such terms as these is a real defect, the omission of the substantival element from apotropism and epitropism does not in the least obscure

* While it is true that the radical signification of the Greek preposition $\epsilon\pi\iota$ is upon, it is often, and no less properly, used as equivalent with the English to, or towards.

their meaning because of the special character of the subject in the discussion of which they are employed.

The terms hypocotyl and epicotyl of Darwin, and hyponasty and epinasty of DeVries are objectionable because, being respectively antithetical terms, they are wanting in correlative construction. That is, in their derivation, ἐπί, upon, to, or toward, is made the antithesis of ὑπό, below, or under; whereas ὑπέρ, above, or over is the proper antithesis of ὑπό. Therefore if hypocotyl is used, its antithetic correlative should be hypercotyl; and similarly the correlative of hyponasty should be hypernasty.

Not only are the terms hypocotyl and epicotyl etymologically defective, but their use as originally proposed is not always structurally appropriate. Darwin proposed these terms to indicate the up-growing and down-growing portions respectively of the germinating plantlet, and it is evident from his use of them that he assumed the axis between the opposing portions to be practically identical in position with the points of attachment of the cotyledons. As a matter of fact, however, the cotyledons do not mark any material division in the structure of the plantlet, and the axis referred to is quite independent of their position. In many plants, the bean, for example, the axis is much below the cotyledons and the latter therefore rise above ground as the plantlet grows; while in many other plants, the pea for example, the axis is above the cotyledons, and the latter therefore remain underground. For this inconspicuous, but real, dividing disk between the up-growing and down-growing portions of the plantlet, and also of the mature plant, I have long personally used the term tropaxis, of partially Latinized Greek derivation; and for the parts above and below the axis I have used the adjective terms apotropic, and epitropic respectively.

The terms proposed by Frank, Darwin, DeVries and others have passed into the literature of botany with all their excellencies and imperfections, while my terms apotropicism, epitropism and tropaxis have never been published although I have for more than thirty years accustomed myself to their use. I still think they have much merit and therefore offer them for consideration in connection with suggestions for correcting the structure and use of certain terms now generally employed.

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SMITHSONIAN INSTITUTION,
June 25, 1900.

*LYMPHOSPORIDIUM TRUTTAE, NOV. GEN.,
NOV. SPEC. THE CAUSE OF A RECENT
BROOK TROUT EPIDEMIC.*

In October, 1899, my attention was called to a disastrous epidemic among the brook trout in a Long Island hatchery. The first evidence of the epidemic was seen in May, 1899, when the director picked out a dead fish from one of the ponds and saw that one side was pierced by a clear-cut hole. Thinking the hole due to some bird like a king-fisher, he threw the fish away without further thought. When, however, he found other dead fish with similar wounds, and when the death-rate became noticeably large, an attempt was made to stop the headway of what was then recognized as a disease. Precautionary measures were useless, and during the summer the fish died off at the rate of hundreds per day. Nor did the disease stop until, in December, every fish in the ponds had died.

Investigation begun in October showed the cause of the trouble to be a hitherto undescribed genus of parasitic Protozoa, which I have named *Lymphosporidium truttae*, belonging to the same class (Sporozoa) as the malaria germ, although the effects of the parasite on the fish are in no way similar to the effect of the malaria-organism in man. Evidences of the disease in the fish were